

Where Are the Interstellar Comets?

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The formation and subsequent dynamical evolution of the solar system resulted in a large number of icy planetesimals, i.e., comets, being ejected to interstellar space. This is an ongoing process: $\sim 65\%$ of all long-period comets and about half of all short-period comets will be dynamically ejected. If planetary systems around other stars behave similarly, then there should be a substantial flux of interstellar comets. However, no comet on a clearly hyperbolic orbit has ever been observed passing through the planetary region. Estimates of the number of comets ejected by the solar system vary depending in particular on the efficiency with which the giant planets place comets in the Oort cloud, versus ejection on hyperbolic orbits. However, those past estimates were based on a relatively narrow range of semimajor axes for capture into the Oort cloud. Duncan et al. (1987 *Astron. J.* 94, 1330) showed that the actual range of possible initial orbits is about three times greater than previously thought, and that most comets are captured into the inner Oort cloud reservoir where they are not easily perturbed, except by close penetrating stellar passages, or by encounters with GMC's. Using this wider range of possible capture orbits, it will be shown that relatively few comets from the Uranus-Neptune zone can actually be ejected, and that even a large fraction of Saturn planetesimals will likely be captured into the Oort cloud, rather than escaping to interstellar space. Only Jupiter has **sufficient** gravity to perturb most of its comets to escape. The result is a far higher ratio of final bound orbits versus ejected ones, leading to a relatively lower production of interstellar comets. One interesting implication is that Oort cloud comets likely formed over a wider range of heliocentric distances than previously thought, which may be reflected in a greater range of cometary compositions. This work was supported by the NASA Origins of Solar Systems and Planetary Geology and Geophysics Programs.

Abstract submitted for DPS [Division for Planetary Sciences] meeting

Date submitted: LPI electronic form version 5/95

Division for Planetary Sciences Abstract Form

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